

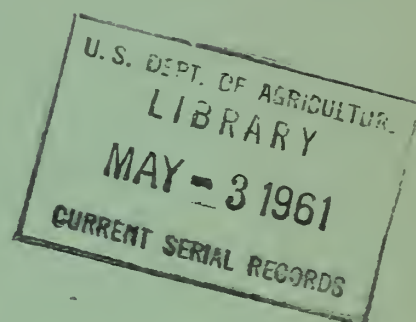
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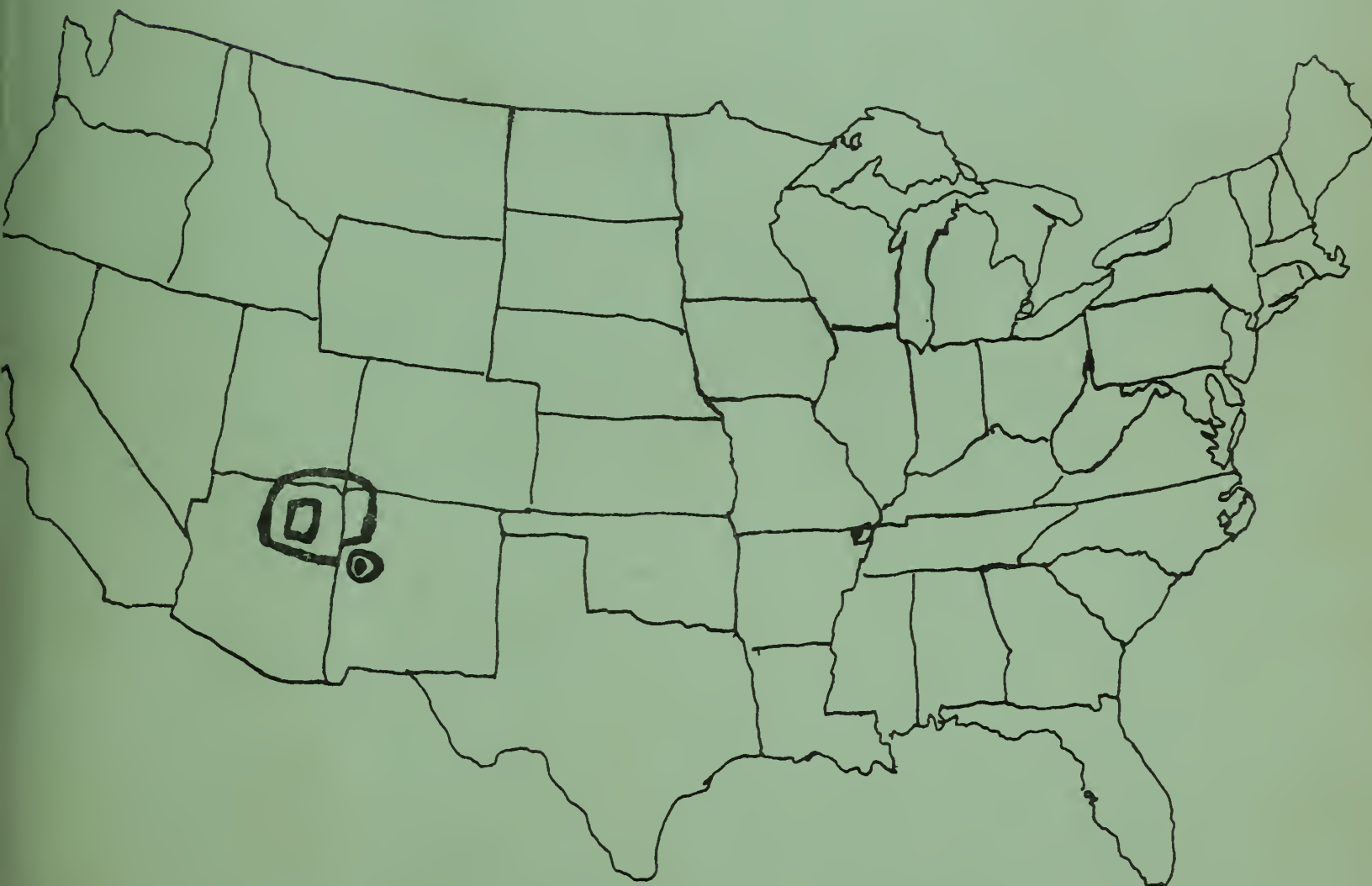
UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION

BUREAU OF ANIMAL INDUSTRY
COOPERATING WITH
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS



ELEVENTH ANNUAL REPORT OF THE
SOUTHWESTERN RANGE AND SHEEP BREEDING LABORATORY
FORT WINGATE, NEW MEXICO

OCTOBER 31, 1947



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USE OF ADMINISTRATIVE LEADERS AND WORKERS IN THIS OR RELATED FIELDS OF
RESEARCH, AND NOT FOR GENERAL DISTRIBUTION.

ANNUAL REPORT OF CONDITIONS AND ACTIVITIES
SOUTHWESTERN RANGE AND SHEEP BREEDING LABORATORY
FORT WINGATE, NEW MEXICO

November 1, 1946 to October 31, 1947

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ROSTER OF PERSONNEL

<u>Name</u>	<u>Title</u>	<u>Date entered on duty</u>	<u>Duties</u>
James O. Grandstaff	Animal Husbandman, P&S-4	Jan. 13, 1944	Director
John V. Christensen	Animal Fiber Tech., P-3	Feb. 3, 1947	Wool Tech.
George M. Sidwell	Animal Husbandman, P-2	Dec. 1, 1946	Genetics
Herbert T. King ¹	Ass't. Animal Husbandman, P-2	Oct. 1, 1936	Operations
Orval LeRoy Navarre	Stockman, CPC-7	Feb. 6, 1947	Operations
Orville D. Propps ²	Scientific Aid, SP-4	Aug. 13, 1945	Lab. Ass't.
Albert G. Dumont	Scientific Aid, SP-5	Feb. 24, 1947	Lab. Ass't.
Edna T. Schild ³	Clerk, CAF-4	Nov. 11, 1946	Clerical
Araminta D. Costello	Clerk-Stenographer, CAF-4	July 1, 1947	Clerical
Jimmie Gleason	Janitor, CPC-4	Apr. 1, 1942	Janitor and Maintenance
Narcissa R. Chadacloi ⁴	Laboratory Aid, SP-3	Oct. 22, 1946	Lab. Aid
Marion Chadacloi	Agricultural Aid, SP-3	Jan. 12, 1944	Assistant
Douglas Roanhorse ⁵	Agricultural Aid, SP-3	Aug. 26, 1946	Assistant
Wilfred G. Bia ⁶	Agricultural Aid, SP-3	Dec. 16, 1946	Assistant
Jerry E. Salabiye ⁷	Agricultural Aid, SP-3	May 16, 1944	Assistant
Billy O'dell	Agricultural Aid, SP-3	Aug. 19, 1946	Assistant
Phoebe Fisher ⁸	Weaver, CPC-4	May 22, 1942	Weaving
Jessie Denetclaw ⁹	Weaver, CPC-4	Oct. 1, 1942	Weaving

1-Resigned: July 7, 1947

2-Resigned: Jan. 9, 1947

3-Transferred: June 23, 1947

4-Resigned: Nov. 10, 1947

5-Resigned: Aug. 1, 1947

6-Resigned: Sept. 15, 1947

7-Resigned: Dec. 31, 1947

8-Admin. furlough: Oct. 17, 1947

9-Admin. furlough: Oct. 13, 1947

OBJECTIVE

The main objective of this laboratory is the development of types of sheep which are adapted to the range conditions of the southwest, and to the economic requirements of Navajo Indians and other sheepmen of this area. In the pursuit of this objective, basic breeding methods are employed, utility values of the wool with respect to hand weaving are studied, and the selection of breeding animals is based upon production as measured under range environment. Emphasis is placed primarily on adaptability and longevity of the sheep, yield of wool and its suitability with respect to hand weaving and commercial manufacture, and the quantity and quality of lambs produced.

RESEARCH LINE PROJECTS

1. Improvement of the wool of Navajo sheep by studying the physical and chemical properties of Navajo wool as found in old Navajo blankets, and in the fleeces of Navajo sheep.
2. Improvement of Navajo sheep by selection and line breeding in the Navajo strain.
3. Improvement of sheep for use of Navajo Indians through crossbreeding of old-type Navajo sheep with improved breeds such as Romney and Corriedale, followed by selective line-breeding matings of the F₁ (and succeeding generations) crossbred animals inter se.
4. Improvement of wool to meet the requirements of Navajo Indians by studying the physical and chemical properties of crossbred wools.

PUBLICATIONS

The following papers have been published since the establishment of the Southwestern Range and Sheep Breeding Laboratory:

1. The Navajo Sheep Industry and Needs for Its Improvement;
J. M. Cooper, The Sheep Breeder, May 1939
2. The Sheep Industry of Indians in the Southwest;
J. M. Cooper and Dewey Dismuke, Indians At Work, August 1939
3. Breeding for Adaptability to Local Conditions, with Special Reference to Sheep on the Navajo Indian Reservation;
J. M. Cooper, American Society of Animal Production, 1939
4. Improvement of the Navajo Sheep;
Cecil T. Blunn, Journal of Heredity, March 1940

5. Breeding for Quality Wool;
James O. Grandstaff, The National Wool Grower, July 1940
6. A Rapid Method for Projecting and Measuring Cross Sections of Wool Fibers;
James O. Grandstaff and Walter L. Hodde, Circular No. 590, U.S. Department of Agriculture, December 1940
7. Evaluating Fleece Characteristics of Navajo Sheep;
James O. Grandstaff, Rayon Textile Monthly, October-November 1941
8. Wool Characteristics in Relation to Navajo Weaving;
James O. Grandstaff, Technical Bulletin No. 790, U.S. Department of Agriculture, January 1942
9. Characteristics and Production of Old-Type Navajo Sheep;
Cecil T. Blunn, Journal of Heredity, May 1943
10. The Influence of Seasonal Differences on the Growth of Navajo Lambs;
Cecil T. Blunn, Journal of Animal Science, February 1944
11. A Preliminary Report on the Post-natal Development of the Fiber Characteristics of the Fleeces of Navajo Sheep;
James O. Grandstaff and Cecil T. Blunn, Journal of Animal Science, May 1944
12. Comparison of the Yields of Side Samples from Weanling and Yearling Sheep;
Cecil T. Blunn and James O. Grandstaff, Journal of Animal Science, May 1944
13. Yearly Differences in Growth of Navajo and Crossbred Ewe Lambs;
Cecil T. Blunn, Journal of Animal Science, August 1945
14. Evaluating Fleece Quality of Navajo Sheep from Small Samples;
James O. Grandstaff and Cecil T. Blunn, Journal of Agricultural Research, September 1945
15. Improvement of Wool for Navajo Hand Weaving;
James O. Grandstaff and Cecil T. Blunn, Indians At Work, March 1945
16. Relation of Kemp and Other Medullated Fibers to Age in the Fleeces of Navajo and Crossbred Lambs;
James O. Grandstaff and Harold W. Wolf, Journal of Animal Science, May 1947
17. Comparison of Corriedale x Navajo and Romney x Navajo Crosses;
James O. Grandstaff, accepted for publication in Journal of Animal Science

SUMMARY OF BREEDING PROGRAM

<u>Line</u>	<u>Pen No.</u>	<u>Ram No.</u>	<u>Breeding of rams</u>	<u>Breeding of ewes</u>	<u>No. of ewes</u>
1	1	23H	Navajo	Navajo	34
1	2	261H	Navajo	Navajo	32
2	3	83E	Navajo	Navajo	52
3	W1	W157H	Crossbred	Crossbred	32
3	W2	W251H	Crossbred	Crossbred	28
3	W3	W6H	Crossbred	Crossbred	27
3	W4	W114H	Crossbred	Crossbred	28
4	W5	W224H	Crossbred	Crossbred	33
4	W6	W244H	Crossbred	Crossbred	33
4	W7	W218H	Crossbred	Crossbred	42
5	W12	51	Lincoln	Crossbred	45
5	W13	382	Lincoln	Crossbred	47
5	W14	468	Lincoln	Crossbred	46
5	W15	1381	Cotswold	Crossbred	48
5	W16	1343	Cotswold	Crossbred	46
6	W8	4785K	Columbia	Navajo	38
6	W9	5228K	Columbia	Navajo	37
6	W10	5002K	Columbia	Navajo	37
6	W11	3734K	Columbia	Navajo	36
7	W17	89	Romney	Navajo	25
7	W18	71	Romney	Navajo	38
7	W19	17	Romney	Navajo	40
Test Pens*	1	W93I	Columbia x Navajo	Crossbred	23
	2	W75I	Cotswold x Crossbred	Crossbred	21
	3	W386I	Cotswold x Crossbred	Crossbred	17
	4	W126I	Columbia x Navajo	Crossbred	13

*crossbred ram lambs used in these pens

SUMMARY OF BREEDING PROGRAM

The breeding flock in 1946 contained a total of 898 ewes, which represented an increase of 14.5 percent compared to the number of ewes bred in 1945. Included in the 1946 total were 353 Navajo ewes and 545 crossbred ewes.

A total of 118 Navajo ewes in lines 1 and 2 were mated to Navajo rams. The number of Navajo matings was higher than in 1945 but scarcely adequate to furnish the number of replacement ewe lambs necessary to maintain the Navajo breeding flock at its present size. A total of 235 Navajo ewes were used for crossbreeding, of which 148 ewes were mated with Columbia rams and 87 ewes were mated with Romney rams.

Two hundred thirty-two of the finer woolled ewes of lines 3 and 4 were mated with Lincoln and Cotswold rams. The remaining crossbred ewes of lines 3 and 4 were mated to the coarsest woolled crossbred rams available within their respective lines.

The ewes were pen bred during the 30-day period from November 8 to December 7.

PROGENY TESTING OF CROSSBRED RAM LAMBS

Four crossbred ram lambs were tested in the fall of 1946 on 87 crossbred ewes. The ram lambs tested included two F₁ Columbia x Navajo and two sired by Cotswold rams and out of crossbred ewes.

CHARACTERISTICS OF BREEDING RAMS

In the selection of breeding rams considerable emphasis has been placed on fleece quality. Such selection has been complicated by the limited number of rams available for use in the Navajo lines as well as crossbred lines 3 and 4. Fleece characteristics receiving the major emphasis are grade, staple length, uniformity, and freedom from kemp and other medullated fibers. Rams of satisfactory body type and producing the coarsest fleeces are preferred, owing to the need for correcting deficiencies in fleece fineness. It is felt that progress toward the desired 48's quality wool will be considerably accelerated by the addition of Lincoln and Romney rams to the crossbreeding program.

The accompanying table summarizes the important fleece characteristics of breeding rams used in the 1946-47 season. Wool samples for use in determining fineness, staple length, uniformity, and kemp and other medullated fibers were taken from the mid-side region of each ram prior to shearing. In the laboratory analysis of the samples the rapid count method was used. The clean fleece weight was calculated from the yield obtained by scouring a side sample. All clean fleece weights are on a "bone-dry" basis.

The three Navajo rams used in the 1946 breeding season were outstanding individuals for body type as well as for fleece quality. Grease fleece weights averaged 6.98 pounds with an average clean fleece weight of 4.34 pounds. The average staple length was 17.2 centimeters. While one ram produced a fleece grading 56's the average diameter of the three rams was 29.8 microns, grade 50's. All rams had well-improved Navajo type fleeces possessing a minimum of outer coat fibers, no kemp, and only one ram had any medullated fibers.

A total of seven crossbred rams were used in lines 3 and 4. The clean fleece weights varied from 3.86 pounds to 6.94 pounds with average clean fleece weights of 5.22 pounds and 4.79 pounds, for the rams used in lines 3 and 4, respectively. Although the average staple length of the line 4 rams was 3.0 centimeters longer than the line 3 rams, the staple length of all crossbred rams was quite satisfactory. The small number of coarse fleeced rams produced in these lines continues to make selection very limited. The average grade for the rams used in both lines was 50's but there was an individual range from 48's to 56's. All fleeces exhibited the characteristics and quality of improved wool. Kemp fibers were entirely lacking and only one ram possessed any other medullated fibers. This ram, No. W224H, had only 3.4 percent of other medullated fibers.

The two Lincoln rams had an average grease and clean fleece production of 17.50 and 11.12 pounds respectively. Staple length averaged 26.2 centimeters with an average fiber diameter of 38.6 microns, grade 40's. There were no kemp fibers in either fleece but one ram, No. 382, had 4.1 percent of other medullated fibers. The other ram, No. 468, was an outstanding ram in body type as well as producing a fleece of excellent character and quality.

As in 1946, the Cotswold rams were somewhat deficient in fleece quality, particularly with respect to medullated fibers. Their fleece production was satisfactory with an average grease fleece weight of 17.42 pounds and a clean fleece weight of 10.30 pounds. The average staple length was 36.0 centimeters with an average fiber diameter of 36.9 microns, equivalent to a grade of 44's. Medullated fibers, other than kemp, were present in the fleeces of both rams with an average of 20.6 percent.

Four Columbia rams were used in the 1946 breeding season. The rams were selected primarily for coarse fleeces but all were of good size and body type. They produced an average grease and clean fleece weight of 11.98 and 5.38 pounds, respectively. There was not much variation in staple length with an average of 11.4 centimeters. The average fiber diameter was 28.8 microns, grade 56's. Only one ram, No. 5228K, produced a fleece coarser than 56's. Kemp fibers were lacking in all fleeces and only one ram possessed any other medullated fibers. This ram, No. 5002K, had 6.5 percent of medullated fibers other than kemp.

The three Romney rams had an average grease fleece production of 11.93 pounds and a clean fleece production of 7.56 pounds. Staple length averaged 20.7 centimeters with an average fiber diameter of 36.7 microns, equivalent to a grade of 44's. Kemp fibers were lacking in the samples of all Romney rams. Medullated fibers, other than kemp, were present to the extent of only 1 percent in the fleece of only one ram.

CHARACTERISTICS OF BREEDING RAMS

Line no.	Ram no.	Age at breeding	Fleece weight as yearling		Staple length (cms.)	Fineness at side		Kemp (percent)	Other med. fibers (percent)
			(lbs.)	(lbs.)		Diameter : Grade (microns)			
NAVAJO RAMS:									
1	23H	1	6.45	3.86	18.0	31.4	50's	0	0
1	261H	1	6.30	4.12	15.0	28.9	56's	0	3.3
2	83E	4	8.20	5.03	18.5	29.2	50's	0	0
Average, Lines 1 & 2									
			6.98	4.34	17.2	29.8	50's	0	1.1
CROSSBRED RAMS:									
3	W157H	1	7.95	4.58	13.5	29.4	50's	0	0
3	W251H	1	7.15	4.25	14.0	30.0	50's	0	0
3	W6H	1	7.60	5.09	16.5	29.4	50's	0	0
3	W114H	1	11.50	6.94	18.0	31.8	48's	0	0
Average, Line 3									
			8.55	5.22	15.5	30.2	50's	0	0
4	W224H	1	8.30	4.72	17.0	29.4	50's	0	3.4
4	W244H	1	8.40	3.86	14.5	30.8	50's	0	0
4	W218H	1	8.75	5.78	24.0	28.7	56's	0	0
Average, Line 4									
			8.45	4.79	18.5	29.6	50's	0	1.1
LINCOLN RAMS:									
5	51*	1							
5	382	1	18.20	11.40	29.0	39.3	36's	0	4.1
5	468	1	16.80	10.85	23.4	38.0	40's	0	0
Average, Lincoln Rams									
			17.50	11.12	26.2	38.6	40's	0	2.0

CHARACTERISTICS OF BREEDING RAMS (con't.)

Line no.	Ram no.	Age at breeding	Fleece weight as yearling		Staple length (cms.)	Fineness at side		Kemp (percent)	Other med. fibers (percent)
			Grease (lbs.)	Clean (lbs.)		Diameter (microns)	Grade		
COTSWOLD RAMS:									
5	1381	12 ¹	17.60	10.44	32.5	39.2	36's	0	10.2
5	1343	2	17.25	10.16	39.5	34.6	46's	0	30.9
Average, Cotswold Rams									
			17.42	10.30	36.0	36.9	44's	0	20.6
COLUMBIA RAMS:									
6	4785K	2	11.26	4.46	10.0	28.2	56's	0	0
6	5228K	1	11.15	5.20	11.8	30.0	50's	0	0
6	5002K	2	10.18	4.14	12.5	28.7	56's	0	6.5
6	3734K	5	15.31	7.73	11.4	28.2	56's	0	0
Average, Columbia Rams									
			11.98	5.38	11.4	28.8	56's	0	1.6
ROMNEY RAMS:									
7	89	Lamb	11.70	6.88	24.5	35.2	46's	0	0
7	71	1	11.80	7.54	18.8	35.8	44's	0	0
7	17	1	12.30	8.27	18.9	39.0	36's	0	1.0
Average, Romney Rams									
			11.93	7.56	20.7	36.7	44's	0	0.3

The fleece data for Lincoln, Cotswold, and Romney rams excepting No. 89 was taken at two years of age. These rams were purchased after their yearling fleeces had been sheared.

*No fleece data available, ram died December 3, 1946.

CHARACTERISTICS OF BREEDING EWES

Line no.	Pen no.	No. of ewes	Age of ewes at lambing (years)	Body weight at 18 mo. (lbs.)	Fleece weight as yearling		Staple length (cms.)	Fineness at side		Kemp (percent)	Other med. fibers (percent)
					Grease (lbs.)	Clean (lbs.)		Diameter (microns)	Grade		

NAVAJO EWES BRED TO NAVAJO RAMS:

1	1	32	5.8	95.9	4.79	2.92	9.8	27.0	58's	0.4	1.6
1	2	30	5.8	96.1	4.76	2.77	9.5	27.9	56's	1.6	2.7
2	3	52	5.6	97.4	4.38	2.75	9.4	26.4	58's	0.7	1.2
Total & Average,											
Lines 1 & 2		114	5.7	96.7	4.60	2.80	9.5	27.0	58's	0.9	1.7

CROSSBRED EWES BRED TO CROSSBRED RAMS:

3	W1	32	4.0	101.2	6.34	3.24	9.5	27.8	56's	0.3	1.7
3	W2	28	3.9	101.3	5.94	3.01	9.0	27.8	56's	0.2	1.6
3	W3	27	4.4	99.2	6.52	3.53	9.3	26.0	58's	0.4	0.8
3	W4	28	4.1	101.4	6.44	3.32	8.9	26.2	58's	0.2	1.7
Total & Average,											
Line 3		115	4.1	100.8	6.31	3.27	9.2	27.0	56's	0.3	1.4
4	W5	33	5.0	103.3	5.68	3.40	9.7	28.3	56's	0.1	0.6
4	W6	32	4.8	105.0	6.41	3.69	9.7	28.5	56's	0.3	1.2
4	W7	42	4.2	106.1	6.22	3.50	9.4	26.7	58's	0.1	0.9
Total & Average,											
Line 4		107	4.6	104.9	6.11	3.52	9.6	27.7	56's	0.2	0.9

CROSSBRED EWES BRED TO LINCOLN RAMS:

5	W12	45	4.8	107.0	6.38	3.05	7.6	24.4	60's	0	0.3
5	W13	47	4.6	106.5	5.85	2.93	8.2	24.4	60's	0.1	0.4
5	W14	45	4.7	105.0	6.01	3.09	8.1	24.3	60's	0	0.1
Total & Average		137	4.7	106.4	6.08	3.02	8.0	24.3	60's	0	0.3

CHARACTERISTICS OF BREEDING EWES (con't.)

Line no.	Pen no.	No. of ewes	Age of ewes at lambing (years)	Body weight at 18 mo. (lbs.)	Fleece weight as yearling		Staple length (cms.)	Fineness at side Diameter : Grade (microns)	Kemp (percent)	Other med. fibers (percent)
					Grease: (lbs.)	Clean (lbs.)				
CROSSBRED EWES BRED TO COTSWOLD RAMS:										
5	W15	47	4.7	107.7	5.96	3.02	8.4	24.4	60's	0.1
5	W16	46	4.6	104.7	5.87	3.03	8.0	25.3	60's	0.2
Total & Average		93	4.7	106.2	5.92	3.03	8.2	24.8	60's	0.1
Total & Average,										
Line 5		230	4.7	106.3	6.01	3.02	8.1	24.6	60's	0.2
NAVAJO EWES BRED TO COLUMBIA RAMS:										
6	W8	37	3.6	95.7	4.65	2.94	9.7	26.3	58's	1.9
6	W9	36	3.3	99.0	5.26	3.10	10.5	27.0	58's	2.3
6	W10	37	3.4	97.9	5.08	3.10	10.4	26.6	58's	2.1
6	W11	35	3.5	98.3	4.88	3.09	10.7	27.3	56's	1.7
Total & Average,		145	3.5	97.7	4.97	3.06	10.2	26.8	58's	2.0
Line 6										
NAVAJO EWES BRED TO ROMNEY RAMS:										
7	W17	25	4.4	94.8	4.45	2.66	8.1	25.7	58's	2.2
7	W18	38	4.0	96.2	4.28	2.52	8.7	25.6	58's	1.1
7	W19	40	4.0	98.6	4.21	2.53	8.4	25.2	60's	0.3
Total & Average,		103	4.1	96.8	4.29	2.56	8.4	25.5	60's	1.1
Line 7										

CHARACTERISTICS OF BREEDING EWES

The preceeding table summarizes the important characteristics, by lines and pens, of the breeding ewes for the 1946-47 season. Data on age at lambing, body weight at 18 months, and various characteristics of the yearling fleeces is included. Wool samples for use in determining fineness, staple length, uniformity, and kemp and other medullated fibers were taken from the mid-side region of each ewe prior to the shearing of the yearling fleeces. In the laboratory analysis of the samples the rapid count method was used. The clean fleece weight was calculated from the yield obtained by scouring a side sample. All clean fleece weights are on a "bone-dry" basis.

The Navajo ewes were segregated into four lines and twelve groups for breeding to Navajo, Columbia, and Romney rams. The Navajo ewes bred to Columbia rams were superior in most characteristics to those bred to Navajo or Romney rams. Navajo ewes bred to Columbia rams averaged 3.5 years of age at lambing and were 2.2 and 0.6 years younger than ewes bred to Navajo and Romney rams, respectively. In wool production the Navajo ewes bred to Columbia rams had an average grease fleece weight of 4.97 pounds and a scoured fleece weight of 3.06 pounds. These figures exceeded the grease and clean fleece weight of the Navajo ewes bred to Navajo rams by 0.37 pound and 0.26 pounds, and exceeded the production of the Navajo ewes bred to Romney rams by 0.68 pounds and 0.58 pounds, respectively. Staple length averages for the Navajo ewes bred to Columbia rams was 10.2 centimeters; for ewes bred to Navajo rams, 9.5 centimeters; and for ewes bred to Romney rams, 8.4 centimeters. The average fiber diameter of Navajo ewes bred to both Columbia and Navajo rams was equivalent to that of grade 58's, while the ewes bred to Romney rams had fleeces averaging one grade higher. Kemp fibers in the three groups were below one percent while the percentage of other medullated fibers were between one and two percent.

The crossbred ewes of lines 3 and 4 were very similar in most characteristics. In age at lambing the ewes of line 4 were 0.5 years younger than line 3 ewes. They were also 4.1 pounds heavier in body weight at eighteen months than the line 3 ewes. The average grease fleece weight of the line 3 ewes was 6.31 pounds, exceeding the line 4 ewes by 0.20 pounds but the line 4 ewes produced an average scoured fleece weight of 3.52 pounds, exceeding the line 3 ewes by 0.25 of a pound. Staple length average for the line 3 ewes was 9.2 centimeters and for the line 4 ewes 9.6 centimeters. The average grade for the ewes of both lines was 56's although the average fiber diameter of line 4 was 27.7 microns, 0.7 microns coarser than the line 3 ewes. Kemp and other medullated fibers were practically negligible in both lines.

The crossbred ewes of line 5 were the finer fibered, short stapled ewes from lines 3 and 4. They were mated with Lincoln and Cotswold rams as corrective matings to produce longer stapled, coarser wooled offspring. They averaged 4.7 years of age at lambing, with an average body weight of 106.3 pounds at eighteen months of age. Yearling grease and clean fleece weights averaged 6.01 and 3.02 pounds, respectively. Staple length averaged 8.1 centimeters. The average fiber diameter was 24.6 microns, equivalent to grade 60's. Kemp and other medullated fibers were practically absent.

LAMB PRODUCTION OF NAVAJO AND CROSSBRED MATINGS

Lamb production of Navajo and crossbred matings in 1947 and the 10-year 1937-46 averages are summarized in the following table. In 1947 the percentages of pregnant ewes for both Navajo and crossbred matings was below average, but the percentages of lambs born and weaned were considerably above average. The decrease in percentages of pregnant ewes was due to low fertility of certain rams as indicated by the pen summaries. The percentage of lambs born from Navajo matings averaged 152.5, an increase of 19.7 percent over the 10-year figure. For crossbred matings the percentage of lambs born was 146.0, a gain of 14.9 percent.

In 1947 the percentages of lambs weaned of ewes bred were 117.8 and 101.1 for Navajo and crossbred matings, respectively. These values exceed the 10-year averages by 16.7 percent for Navajo matings and 8.6 percent for crossbred matings, and are far above average for the southwestern states. Although the Navajo ewes have consistently weaned a higher percentage of lambs than did the crossbred ewes having about one half Navajo blood, it will be noted that the 1947 production of all crossbred matings was equal to the 10-year average for Navajo matings. The gain in 1947 with respect to percentages of lambs weaned resulted primarily from an increase in percentages of twin lambs born. Also there was a slight decrease in mortality of lambs from birth to weaning age in 1947 compared to the 10-year average.

The adjusted average weaning weights of Navajo and crossbred lambs in 1947 were 60.5 pounds and 68.0 pounds, respectively. These values exceed the 10-year averages by 3.1 and 8.4 pounds. The advantage of the crossbred lambs in weaning weight reflects their ability to make good gains when adequate feed is available.

In 1947 Navajo matings produced an average of 71.9 pounds of lamb per ewe bred, exceeding their 10-year average by 13.7 pounds. Crossbred matings weaned an average of 68.6 pounds of lambs per ewe bred, a gain of 13.7 pounds compared to their 10-year average. For both Navajo and crossbred matings the gain in pounds of lamb weaned per ewe resulted from improvement in average weaning weights of lambs and in the percentages of lambs weaned of ewes bred. Large differences between pens, in pounds of lamb produced per ewe, are closely associated with differences in the percentages of pregnant ewes and percentages of lambs born, which strongly emphasize the importance of selecting breeding rams and ewes for high fertility.

GROWTH RATES OF NAVAJO AND CROSSBRED LAMBS

Navajo and crossbred lambs born during the middle two weeks of the 1947 lambing season were weighed individually at 28-day intervals from birth to 140 days of age. Body weights were taken for 83 Navajo and 461 crossbred

LAMB PRODUCTION OF NAVAJO AND CROSSBRED MATINGS

Line no.	Pen no.	No. of ewes bred	Percent of ewes pregnant	Percent of lambs born of ewes lambing	Percent of lambs weaned of ewes bred	Percent of lambs weaned of live lambs born	Average weaning weight	Pounds of lamb per ewe bred
NAVAJO EWES BRED TO NAVAJO RAMS:								
1	1	34	85.3	148.3	120.6	95.4	60.1	74.0
1	2	32	68.8	140.9	87.5	90.3	62.0	53.8
2	1	52	92.3	160.4	134.6	90.9	60.0	81.7
Total & Average		118	83.9	152.5	117.8	92.0	60.5	71.9
CROSSBRED EWES BRED TO CROSSBRED RAMS:								
3	W1	32	50.0	150.0	65.6	87.5	67.2	44.4
3	W2	28	89.3	140.0	114.3	91.4	65.1	74.6
3	W3	27	85.2	156.5	125.9	94.4	62.7	78.8
3	W4	28	96.4	144.4	107.1	76.9	66.7	69.8
Total & Average		115	79.1	147.2	101.7	87.3	65.0	66.0
4	W5	33	87.9	148.3	109.1	83.7	69.9	75.0
4	W6	33	87.9	141.4	100.0	80.5	69.1	69.3
4	W7	42	95.2	147.5	128.6	91.5	62.6	82.1
Total & Average		108	90.7	145.9	113.9	86.0	66.6	76.0
CROSSBRED EWES BRED TO LINCOLN RAMS:								
5	W12	45	57.8	150.0	68.9	79.5	66.3	46.6
5	W13	47	83.0	141.0	104.3	89.1	67.8	71.0
5	W14	46	93.5	162.8	128.3	84.3	68.4	87.2
Total & Average		138	78.3	151.8	100.7	84.8	67.8	68.0

LAMB PRODUCTION OF NAVAJO AND CROSSBRED MATINGS (con't.)

Line no.	Pen no.	No. of ewes bred	Percent of ewes pregnant	Percent of lambs born of ewes lambing	Percent of lambs weaned of ewes bred	Percent of lambs weaned of live lambs born	Average weaning weight	Pounds of lamb per ewe bred
<u>CROSSBRED EWES BRED TO COTSWOLD RAMS:</u>								
5	W15	48	64.6	145.2	75.0	80.0	72.1	53.8
5	W16	46	95.6	152.3	113.0	77.6	71.6	82.1
Total & Average		94	79.8	149.3	93.6	78.6	71.8	67.6
<u>NAVAJO EWES BRED TO COLUMBIA RAMS:</u>								
6	W8	38	89.5	138.2	105.3	85.1	71.3	75.3
6	W9	37	89.2	130.3	97.3	83.7	72.2	69.5
6	W10	37	70.3	126.9	78.4	87.9	70.8	55.5
6	W11	36	66.7	166.7	77.8	70.0	66.9	53.9
Total & Average		148	79.0	139.3	89.9	81.6	70.6	63.7
<u>NAVAJO EWES BRED TO ROMNEY RAMS:</u>								
7	W17	25	100.0	140.0	120.0	85.7	67.7	81.3
7	W18	38	89.5	155.9	115.8	83.0	68.2	74.7
7	W19	40	92.5	135.1	100.0	80.0	64.5	65.3
Total & Average		103	93.2	143.8	110.7	82.6	66.8	72.6
1937-46 TOTAL & AVERAGE:								
Navajo matings		2597	88.4	132.8	101.3	89.5	57.4	58.2
Crossbred matings		3010	83.3	131.8	92.5	84.3	59.6	55.1

lambs, representing six different strains or crosses. These data will be used in a study of factors affecting growth rates of the lambs.

The body weights and standard deviations for seven groups of lambs weighed at six different ages are summarized in the following table:

Breeding	Lambs number	AGE					
		Birth pounds	4 weeks pounds	8 weeks pounds	12 weeks pounds	16 weeks pounds	20 weeks pounds
Navajo	83	7.6	16.9	31.7	42.9	53.6	59.8
Crossbred (Line 3)	84	8.3	19.1	34.5	46.4	57.0	63.2
Crossbred (Line 4)	83	8.4	19.7	35.4	48.1	59.1	65.2
Columbia x Navajo	102	8.7	20.1	36.7	50.5	62.7	70.2
Romney x Navajo	69	8.7	19.9	35.9	49.1	60.4	67.4
Lincoln x Crossbred	72	9.2	21.2	37.2	50.7	61.6	67.8
Cotswold x Crossbred	51	9.2	22.0	38.2	51.7	63.1	71.0

All groups of crossbred lambs were heavier than the Navajo lambs at all ages, the differences at 140 days of age ranging from 3.4 pounds to 10.5 pounds. Except for the lambs of line 3, all groups of crossbred lambs showed greater individual variation in body weight at all ages than did the Navajo lambs.

Average daily gain of Navajo lambs from birth to 140 days of age was 0.37 pound. Among the crossbred groups the lambs sired by Columbia and Cotswold rams ranked first with an average daily gain of 0.44 pound, lambs sired by Romney and Lincoln rams were second with 0.42 followed by the lambs of lines 4 and 3 with 0.41 pound and 0.39 pound, respectively.

Type of birth was an important factor affecting growth rate of the lambs. Single lambs were heavier than twin lambs at all ages and for all groups. The mean difference for Navajo single and twin lambs at 140 days of age was 10.8 pounds, while for the crossbred groups the advantage in weight of single lambs compared to twin lambs varied from 4.6 pounds for line 3 to 11.9 pounds for the Cotswold crossbreds.

Differences in growth rates of the lambs were also influenced by the factor of sex. Navajo ram lambs were heavier than ewe lambs at all ages, mean differences ranging from 0.2 pound at birth to 7.6 pounds at 140 days of age. Among crossbred groups the advantage in weight for ram lambs was less than the figure observed for the Navajo group but varied from 1.1 pounds to 6.5 pounds. These differences are somewhat less than normal as the ram lambs were weaned at much younger ages than were the ewe lambs, and weaning at an early age naturally retards development of the lambs for a time.

FIBER CHARACTERISTICS OF NAVAJO AND CROSSBRED LAMBS
AT WEANING AGE

Line no.	Pen no.	No. of lambs	<u>Fineness at side</u> Diameter : Grade (microns)		Staple length (cms.)	Kemp (%)	Other med. fibers (%)
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NAVAJO EWES BRED TO NAVAJO RAMS:

1	1	40	28.1	56's	8.7	0.1	0.4
1	2	28	27.6	56's	8.3	0	0.8
2	3	69	27.6	56's	7.4	0	0.4
Total & Average, Lines 1 & 2		137	27.8	56's	7.9	0	0.4

CROSSBRED EWES BRED TO CROSSBRED RAMS:

3	W1	22	28.2	56's	5.9	0.1	0.4
3	W2	30	28.2	56's	5.9	0.3	0.6
3	W3	36	29.0	56's	7.8	0.6	2.0
3	W4	31	27.4	56's	9.6	0.3	0.6
Total & Average, Line 3		119	28.2	56's	7.4	0.3	1.0

4	W5	36	28.3	56's	8.0	0	1.5
4	W6	33	28.9	56's	6.4	0.1	0.9
4	W7	53	26.9	58's	7.8	0.3	0.2
Total & Average, Line 4		122	27.9	56's	7.4	0.2	0.8

CROSSBRED EWES BRED TO LINCOLN RAMS:

5	W12	31	28.4	56's	7.6	0	1.5
5	W13	47	28.0	56's	7.8	0.1	3.4
5	W14	57	29.3	50's	7.6	0	1.7
Total & Average		135	28.6	56's	7.7	0	2.2

CROSSBRED EWES BRED TO COTSWOLD RAMS:

5	W15	35	28.6	56's	8.9	0	1.7
5	W16	51	29.7	50's	8.5	0	1.9
Total & Average		86	29.2	50's	8.7	0	1.8

Total & Average, Line 5		221	28.9	56's	8.1	0	2.1
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FIBER CHARACTERISTICS OF NAVAJO AND CROSSBRED LAMBS
AT WEANING AGE (con't.)

Line no.	Pen no.	No. of lambs	<u>Fineness at side</u> Diameter : Grade (microns)		Staple length (cms.)	Kemp (%)	Other med. fibers (%)
<u>NAVAJO EWES BRED TO COLUMBIA RAMS:</u>							
6	W8	40	27.8	56's	7.2	0.1	0.5
6	W9	36	28.4	56's	6.2	0.2	1.8
6	W10	29	27.4	56's	5.7	0	3.7
6	W11	27	28.0	56's	6.9	0	1.4
Total & Average, Line 6		132	27.9	56's	6.6	0.1	1.7

NAVAJO EWES BRED TO ROMNEY RAMS:

7	W17	27	28.5	56's	5.2	0	0.4
7	W18	43	28.1	56's	6.3	0	0.6
7	W19	40	29.9	50's	6.0	0.1	0.1
Total & Average, Line 7		110	28.9	56's	6.0	0	0.4

FIBER CHARACTERISTICS OF WEANLING LAMBS

At weaning time wool samples were collected from the middle of the left side of each lamb. These samples were used for the determination of fineness, staple length, and percentages of kemp and other medullated fibers. In the laboratory analysis of the samples the rapid count method was used for determining fineness and percentages of kemp and other medullated fibers. Staple length measurements, in all cases, are adjusted to 140 days of growth. The accompanying table summarizes the fiber characteristics of the lambs by lines and pens.

The straight-bred Navajo lambs had an average fiber diameter of 27.6 microns, grade 56's. Staple length averaged 7.4 centimeters, the longest of any group of lambs except those sired by Cotswold rams. Kemp fibers were completely lacking and only 0.4 percent of other medullated fibers were present in the weanling samples.

The lambs resulting from the matings of Navajo ewes with Columbia rams exhibited distinctly improved type fleeces. The average grade of the line was 56's but a range in average fiber diameter of 27.4 to 28.4 microns was observed between the various pens within the line. Average staple length was 6.6 centimeters, 1.3 centimeters shorter than the straight Navajo lambs. Kemp and other medullated fibers averaged 0.1 percent and 1.7 percent, respectively.

The crossbred progeny of Navajo ewes bred to Romney rams had an average fiber diameter of 28.9 microns, one micron coarser than the Columbia crossbred lambs, although the average grade of 56's was the same. Staple length averaged 6.0 centimeters. Kemp fibers were completely lacking and only 0.4 percent of other medullated fibers were present.

The crossbred lambs of lines 3 and 4 were very similar in fiber characteristics. Average fiber diameter for the lambs of line 3 was 28.2 microns and 27.9 microns for the lambs of line 4. The grade equivalent was 56's in both lines. Staple length averaged the same for both lines at 7.4 centimeters. Kemp and other medullated fibers averaged 0.3 percent and 1.0 percent, respectively, for line 3 and 0.2 percent and 0.8 percent for line 4.

The lambs of line 5 are the progeny of fine fleeced crossbred ewes mated with Lincoln and Cotswold rams. Lincoln sired lambs had an average fiber diameter of 28.6 microns, grade 56's. Staple length averaged 7.6 centimeters. No kemp fibers were present but an average of 2.2 percent of other medullated fibers were found. The Cotswold sired lambs were superior to the Lincoln sired lambs in most fiber characteristics. They were a grade coarser than the Lincoln sired lambs with an average fiber diameter of 29.2 microns, grade 50's. The average staple length of the Cotswold sired lambs was 8.7 centimeters, 1.0 centimeters longer than the Lincoln sired lambs. No kemp fibers and only 1.8 percent of other medullated fibers were found in the weanling samples from the Cotswold crossbred lambs.

FACE AND BODY SCORES FOR WEANLING LAMBS

All lambs were scored for face covering, body type and condition at approximately 140 days of age. These data are summarized by breeding pens and lines in the accompanying table.

Navajo lambs were more uniform than crossbred lambs with respect to the traits measured. On the basis of average values the Navajo lambs had less face covering than crossbred lambs while all pens of crossbred lambs were superior to Navajo lambs in body type and condition.

Lambs sired by Cotswold rams and out of crossbred ewes having about one half Navajo and one half improved blood, had slightly more face covering but were somewhat superior in body type and condition to the lambs of any other crossbred line. On type and condition these lambs scored about 0.8 of a grade better than Navajo lambs. Lambs sired by Lincoln rams and out of crossbred ewes were almost equal in type to those sired by Cotswold rams, but had less condition and less face covering.

Comparing the lambs sired by Columbia and Romney rams and out of Navajo ewes it is found that the two groups were about equal with respect to face covering and type. The Columbia crossbreds had a little more condition than lambs of the Romney cross. Neither group scored quite as high in body type as the Cotswold

FACE AND BODY SCORES FOR NAVAJO AND CROSSBRED LAMBS AT WEANING AGE

Line no.	Pen no.	No. of lambs	Face covering	Type	Condition
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NAVAJO EWES BRED TO NAVAJO RAMS:

1	1	28	2.77	3.28	3.31
1	2	11	2.54	3.36	3.38
2	3	46	2.75	3.33	3.33

Total & Average		85	2.71	3.32	3.34
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CROSSBRED EWES BRED TO CROSSBRED RAMS:

3	W1	21	3.13	2.76	2.77
3	W2	31	3.25	2.83	2.79
3	W3	38	2.94	3.03	2.87
3	W4	29	2.74	2.77	2.61

Total & Average		109	3.00	2.86	2.76
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CROSSBRED EWES BRED TO CROSSBRED RAMS:

4	W5	40	3.27	2.80	2.90
4	W6	34	3.01	2.61	2.74
4	W7	50	3.01	2.84	2.85

Total & Average		124	3.10	2.78	2.84
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CROSSBRED EWES BRED TO LINCOLN RAMS:

5	W12	29	3.19	2.52	2.63
5	W13	49	3.03	2.67	2.92
5	W14	57	2.96	2.55	2.62

Total & Average		135	3.04	2.58	2.73
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CROSSBRED EWES BRED TO COTSWOLD RAMS:

5	W15	35	3.38	2.63	2.63
5	W16	50	3.13	2.44	2.54

Total & Average		85	3.23	2.52	2.58
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FACE AND BODY SCORES FOR NAVAJO AND CROSSBRED LAMBS AT WEANING AGE (con't).

Line no.	Pen no.	No. of lambs	Face covering	Type	Condition
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NAVAJO EWES BRED TO COLUMBIA RAMS:

6	W8	39	2.93	2.58	2.58
6	W9	37	3.30	2.76	2.69
6	W10	29	2.96	2.65	2.49
6	W11	26	2.94	2.70	2.71

Total & Average		131	3.04	2.67	2.61
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NAVAJO EWES BRED TO ROMNEY RAMS:

7	W17	31	3.05	2.60	2.71
7	W18	40	3.13	2.74	2.88
7	W19	35	3.05	2.68	2.81

Total & Average		106	3.08	2.68	2.81
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and Lincoln crossbreds but were quite similar to the latter with respect to face covering and condition.

The crossbred lambs of line 3 and 4 have approximately one half Navajo and one half improved blood, the latter being predominately from the Corriedale and Romney breeds. The progeny of these two lines were average with respect to face covering and a little below average in type and condition.

WOOL PRODUCTION OF YEARLING EWES

Just prior to shearing two wool samples, a coin envelope and a can sample, were taken from the middle of the left side of all yearling ewes. In the laboratory analysis of the samples the coin envelope samples were used for the determination of staple length, fineness, and percentages of kemp and other medullated fibers. The can samples were scoured for shrinkage determination. At shearing time all fleeces were weighed to the nearest 0.05 of a pound. The estimated clean fleece weights are based on yields of the side samples. Data on the various fiber and productive characteristics of the yearling ewes are summarized in the following table. All fleece weights and staple length measurements are adjusted to a twelve months' basis.

A total of thirty-nine straight-bred Navajo yearling ewes were retained. They had an average clean fleece weight of 3.52 pounds. Staple length averaged 11.4 centimeters with an averaged fiber diameter of 31.6 microns, equivalent to grade 48's. The average percentages of kemp and other medullated fibers were only 0.1 and 3.0, respectively.

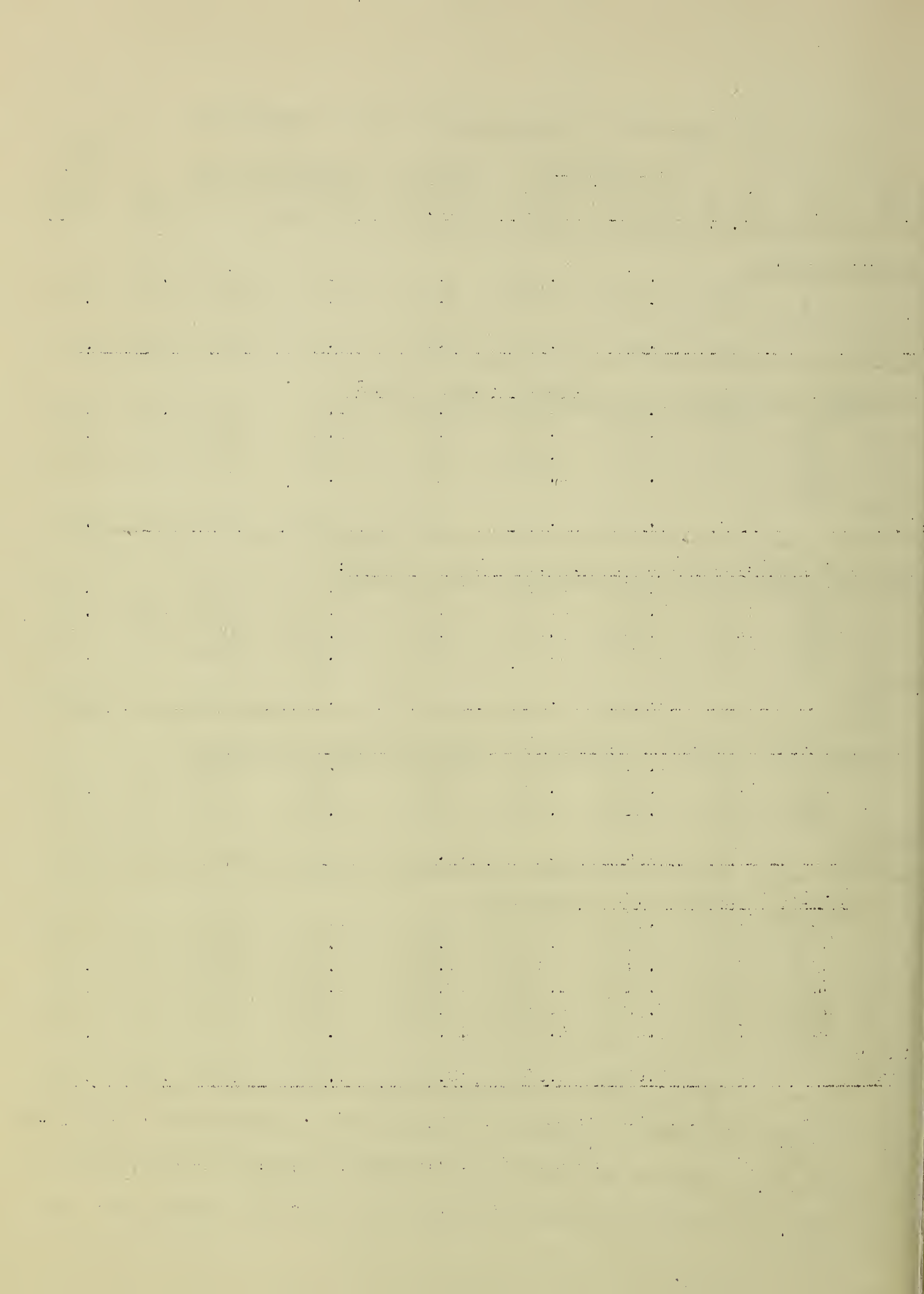
WOOL PRODUCTION OF YEARLING NAVAJO AND CROSSBRED EWES

Line no.	Pen no.	No. of ewes	Fleece weight		Staple length (cms.)	Fineness at side		Kemp (%)	Other med. fibers (%)
			Grease : (lbs.)	Clean (lbs.)		Diameter : (microns)	Grade		
STRAIGHT NAVAJO:									
1	1	21	5.41	3.50	11.3	31.8	48's	0.2	3.6
2	2	18	4.83	3.56	11.6	31.3	50's	0	2.3
Total & Average		39	5.14	3.52	11.4	31.6	48's	0.1	3.0
CROSSBRED; 1/2 NAVAJO, 1/4 CORRIEDALE, AND 1/4 ROMNEY: ¹									
3	W7	18	5.70	2.64	9.6	30.1	50's	0.1	2.9
3	W8	19	6.60	3.87	9.2	29.2	50's	0	0.7
3	W9	6	6.09	2.86	8.1	32.9	48's	0	2.2
3	W10	14	6.67	2.79	8.9	29.9	50's	0.1	1.3
Total & Average		57	6.29	3.12	9.1	30.0	50's	0	1.7
CROSSBRED; 1/2 NAVAJO, 1/4 CORRIEDALE, AND 1/4 ROMNEY: ²									
4	W11	6	6.27	2.71	10.6	30.5	50's	0	1.0
4	W12	12	7.00	4.01	10.6	31.2	50's	0.1	2.2
4	W13	14	6.16	3.28	10.3	29.7	50's	0	1.8
4	W14	16	5.27	3.19	8.8	31.3	50's	0	1.6
Total & Average		48	6.08	3.36	9.9	30.7	50's	0	1.7
CROSSBRED; 1/4 NAVAJO, 1/4 CORRIEDALE OR ROMNEY, AND 1/2 COTSWOLD: ³									
5	W15	25	7.10	4.63	12.7	32.7	48's	0.2	2.8
5	W16	22	6.55	3.89	12.4	33.3	48's	0.1	2.3
5	W17	10	7.41	3.85	14.0	35.0	46's	0	2.5
Total & Average		57	6.94	4.21	12.8	33.3	48's	0.1	2.6
CROSSBRED; 1/2 NAVAJO AND 1/2 COLUMBIA:									
6	W1	12	6.76	3.90	10.2	31.7	48's	0	2.6
6	W2	10	7.67	3.82	11.3	31.4	50's	0.5	2.4
6	W3	11	8.71	4.13	11.0	31.6	48's	0	1.6
6	W4	15	8.01	4.08	10.5	31.2	50's	0	2.1
6	W5	10	7.52	4.58	10.7	30.0	50's	0	1.6
6	W6	12	7.48	4.39	11.7	32.4	48's	0.1	3.2
Total & Average		70	7.68	4.15	10.9	31.4	50's	0.1	2.3

¹The rams were originally the result of Romney x Navajo and the ewes were Corriedale x Navajo.

²The rams were originally the result of Corriedale x Navajo and the ewes were Romney x Navajo.

³The rams were purebred Cotswold and the ewes were the finer fleeced ewes from lines 3 and 4.



The yearling ewes of line 6 are the result of Navajo x Columbia matings. Their average grease and clean fleece weights were 7.68 pound and 4.15 pounds, respectively. The average staple length was 10.9 centimeters. Fiber diameter averaged 31.4 microns, grade 50's. Kemp and other medullated fibers were noticeably low with only 0.1 percent and 2.3 percent, respectively.

The crossbred ewes of line 3 had an average grease fleece weight of 6.29 pound and an average clean fleece weight of 3.12 pounds. Staple length averaged 9.1 centimeters with an average fiber diameter of 30.0 microns, equivalent to a grade of 50's. The samples contained no kemp and an average of only 1.7 percent of medullated fibers other than kemp.

Line 4 crossbred yearling ewes had an average grease and clean fleece weight of 6.08 pounds and 3.36 pounds, respectively. The staple length averaged 9.9 centimeters with an average fiber diameter of 30.7 microns, grade 50's. As in line 3, no kemp fibers were present and there was only 1.7 percent of other medullated fibers.

The yearling ewes of line 5 were sired by Cotswold rams. Their dams were the finer fleeced, short stapled ewes from lines 3 and 4. These yearlings had an average grease fleece weight of 6.94 pounds and an average clean fleece weight of 4.21 pounds. The staple length averaged 12.8 centimeters. Fiber diameter averaged 33.3 microns, equivalent to a grade of 48's. The average percentages of kemp and other medullated fibers were only 0.1 percent and 2.6 percent, respectively.

WOOL PRODUCTION OF YEARLING RAMS

Procedures used in evaluating the fiber and fleece characteristics of yearling rams were the same as those used for the yearling ewes. However, more rigid selection was practiced for both fleece and body characteristics before rams were retained for either breeding or sale. The accompanying table summarizes the fiber and productive characteristics of the yearling rams.

Only two Navajo rams were retained for breeding use. They were similar in both fleece production and fiber characteristics. Fleece weights, grease and clean basis, averaged 7.18 and 4.14 pounds, respectively. An average staple length of 17.8 centimeters was measured with a fiber diameter of 33.6 microns, grade 46's. No kemp or other medullated fibers were found in the side samples of either ram.

A total of sixteen Navajo x Columbia rams from line 6 were saved. These rams had an average grease fleece weight of 10.68 pounds with a yield of 5.06 pounds clean wool. The average staple length was 16.8 centimeters. Fiber diameter averaged 32.5 microns, equivalent to 48's grade. No kemp fibers were found in the samples and only 1.7 percent of other medullated fibers were present.

Line 3 crossbred yearling rams had an average grease and clean fleece weight of 9.08 pounds and 4.48 pounds, respectively. Staple length averaged 15.5 centimeters with an averaged fiber diameter of 31.9 microns, grade 48's. No kemp fibers and only 0.1 percent of other medullated fibers were observed in the fleece samples from these rams.

The 10 crossbred rams saved from line 4 had an average grease fleece weight of 7.91 pounds and an average clean fleece weight of 3.72 pounds. The average staple length was 13.5 centimeters. Fiber diameter averaged 32.3 microns, grade 48's. The samples contained no kemp fibers and there was only 0.8 percent of other medullated fibers.

The yearling rams of line 5, sired by Cotswold rams, had an average grease and clean fleece weight of 9.68 pounds and 5.35 pounds, respectively. Staple length averaged 21.8 centimeters with an average fiber diameter of 33.5 microns, equivalent to a grade of 48's. While no kemp fibers were present, the samples contained an average of 2.1 percent of other medullated fibers.

WOOL PRODUCTION OF YEARLING NAVAJO AND CROSSBRED RAMS

Line no.	No. of rams	Fleece weight		Staple length (cms.)	Fineness-at side		Kemp (%)	Other med. fibers (%)
		Grease : Clean (lbs.) (lbs.)	Diameter : Grade (microns)					
<u>STRAIGHT NAVAJO:</u>								
1	1	7.63	4.60	16.7	33.0	48's	0	0
2	1	6.72	3.67	18.8	34.2	46's	0	0
Total & Average	2	7.18	4.14	17.8	33.6	46's	0	0
<u>CROSSBRED; 1/2 NAVAJO AND 1/2 COLUMBIA:</u>								
6	16	10.68	5.06	16.8	32.5	48's	0	1.7
<u>CROSSBRED; 1/2 NAVAJO, 1/4 CORRIEDALE, AND 1/4 ROMNEY:</u>								
3	15	9.08	4.48	15.5	31.9	48's	0	0.1
<u>CROSSBRED; 1/2 NAVAJO, 1/4 CORRIEDALE, AND 1/4 ROMNEY:</u>								
4	10	7.91	3.72	13.5	32.3	48's	0	0.8
<u>CROSSBRED; 1/4 NAVAJO, 1/4 CORRIEDALE OR ROMNEY, AND 1/2 COTSWOLD:</u>								
5	21	9.68	5.35	21.8	33.5	48's	0	2.1

COMMERCIAL GRADES OF YEARLING NAVAJO AND CROSSBRED EWE FLEECES

A frequency distribution of the yearling Navajo and crossbred ewes by commercial wool grades is given in the following table:

COMMERCIAL GRADES							
Line	No. of ewes	Fine Percent	1/2 Bld. Percent	3/8 Bld. Percent	1/4 Bld. Percent	Low 1/4 Bld. Percent	Common Percent
<u>STRAIGHT NAVAJO:</u>							
1 & 2	39			10.3	79.4	10.3	
<u>CROSSERED; 1/2 NAVAJO AND 1/2 COLUMBIA:</u>							
3	57		22.8	8.8	56.1	12.3	
<u>CROSSERED; 1/2 NAVAJO, 1/4 CORRIEDALE, AND 1/4 ROMNEY:</u>							
4	48	4.2	14.6	10.4	47.9	18.7	4.2
<u>CROSSBRED; 1/4 NAVAJO, 1/4 CORRIEDALE OR ROMNEY, AND 1/2 COTSWOLD:</u>							
5	57			3.5	49.1	28.1	19.3
<u>CROSSBRED; 1/2 NAVAJO AND 1/2 COLUMBIA:</u>							
6	70		7.1	10.0	64.3	18.6	

In 1946 there was a marked improvement in the percentage of fleece of the coarser grades, particularly Quarter Blood.

There were no straight-bred Navajo yearlings producing Fine or One Half Blood wool. Of the 39 ewes saved for replacements, 10.3 percent produced wool equal in average fiber diameter to that of Three Eights Blood wool, 79.4 percent corresponded to Quarter Blood, and 10.3 percent to Low Quarter Blood wool.

The F₁ Columbia x Navajo ewes of line 6 were not as uniform in wool grade as the Navajo yearlings. Of the 70 yearling crossbred ewes saved, 7.1 percent produced fleeces grading One Half Blood, 10.0 Percent graded Three Eights Blood, 64.3 percent graded Quarter Blood, and 18.6 percent were Low Quarter Blood.

The fleeces from 57 yearling crossbred ewes of line 3 covered a range of four grades. Of these, 22.8 percent produced One Half Blood wool, 8.8 percent had Three Eights Blood, 56.1 percent had Quarter Blood, and 12.3 percent had Low Quarter Blood fleeces.

The 48 yearling ewes of line 4 were distributed into six grades with a majority in the Quarter Blood group. The percentage of ewes classified according to grade were as follows: Fine, 4.2 percent; One Half Blood, 14.6 percent; Three Eights Blood, 10.4 percent; Quarter Blood, 47.9 percent; Low Quarter Blood, 18.7 percent; and Common, 4.2 percent.

As would be expected, the yearling ewes of line 5, sired by Cotswold rams, produced coarser fleeces than ewes of other lines. The 57 ewes saved were distributed into four grades with 3.5 percent producing Three-eighths Blood fleeces, 49.1 percent Quarter Blood fleeces, 28.1 percent Low Quarter Blood, and 19.3 percent producing fleeces grading Common.

COMPARISON OF WOOL PRODUCTION OF DAUGHTERS AND DAMS

The following tabulation lists the average yearling fleece weights, diameter, and grades of wool of daughters and dams by the various lines of breeding:

Line no.	No. of ewes		Fleece weight		Fineness at side	
			Grease : (lbs.)	Clean (lbs.)	Diameter : (microns)	Grade
<u>STRAIGHT NAVAJO:</u>						
1 & 2	81	Dams	4.78	2.75	24.4	60's
1 & 2	39	Daughters	5.14	3.52	31.6	48's
<u>CROSSBRED; 1/2 NAVAJO, 1/4 CORRIEDALE, AND 1/4 ROMNEY:</u>						
3	150	Dams	6.66	3.61	26.0	58's
3	57	Daughters	6.29	3.12	30.0	50's
<u>CROSSBRED; 1/2 NAVAJO, 1/4 CORRIEDALE, AND 1/4 ROMNEY:</u>						
4	151	Dams	6.31	3.60	27.0	58's
4	48	Daughters	6.08	3.36	30.7	50's
<u>CROSSBRED:</u>						
5	151	Dams	6.33	3.14	24.4	60's
5	57	Daughters	6.94	4.21	33.3	48's
<u>CROSSBRED:</u>						
6	186	Dams	5.40	3.29	26.6	58's
6	70	Daughters	7.68	4.15	31.4	50's

An increase in wool production is noted in most instances. Clean fleece weights, listed on a "bone-dry" basis, are calculated from the yield obtained by scouring a side sample. Improvement toward the desired coarser grades of wool is evident in all lines by daughters compared to their dams. Fineness determinations are for samples removed from the mid-side before shearing of the yearling fleeces.

An average clean fleece weight of 3.52 pounds for the Navajo yearling ewes represents a gain of 0.77 pound compared with the production of their dams. With an average fiber diameter of 31.6 microns, the Navajo yearling ewes were 7.7 microns coarser than their dams. The average was 48's for the yearling ewes and 60's for their dams.

The Navajo ewes of line 6 had an average clean fleece weight of 3.29 pounds while their daughters sired by Columbia rams averaged 4.15 pounds, or a gain of 0.86 of a pound. The yearling ewes had an average fiber diameter of 31.4 microns, equivalent to a grade of 50's which was two grades coarser than their dams.

The crossbred dams of line 3, with an average clean fleece weight of 3.61 pounds, exceeded the production of their daughters by 0.49 pounds. This condition possibly was the result of the culling of all yearling ewes in this line of breeding producing hairy, off-type fleeces. The yearling ewes were coarser fleeced, on the average, than their dams. Their average fiber diameter of 30.0 microns, grade 50's, was 4.0 microns and two grades coarser than their dams.

As in line 3, the average clean fleece weight of dams exceeded their daughters. The average clean fleece weight was 3.60 pounds for dams and 3.36 pounds for their daughters. Possible explanation for this condition is the same as for line 3. Similar to line 3, the yearling ewes of line 4 were coarser fleeced than their dams. With an average fiber diameter of 30.7 microns, grade 50's, the yearling ewes were 3.7 microns and two grades coarser, on the average, than their dams.

The ewes of line 5 were the finer fleeced, shorter stapled ewes taken from lines 3 and 4. Their clean fleece weight averaged 3.14 pounds. Their yearling daughters sired by Cotswold rams had a clean fleece production averaging 4.21 pound, 1.07 pounds heavier than the average of their dams. Fiber diameter of the daughters, averaging 33.3 microns, was 8.9 microns coarser than the average of their dams. Grade average for the yearling ewes was 48's while the average for their dams was 60's.

BODY WEIGHTS AND SCORES OF YEARLING NAVAJO AND CROSSBRED EWES

A total of 232 crossbred yearling ewes and 39 Navajo yearling ewes were scored for face covering and color before they were sheared. Body weights and type and condition scores were obtained immediately after the ewes were sheared. The data are summarized by lines and breeding pens in the following table.

As might be expected the Navajo ewes were lighter in weight and less desirable with respect to type and condition than the ewes of any crossbred line. The Navajo ewes, however, had less face covering than crossbred ewes, excepting those in line 4 and were average with respect to amount of color on face and legs.

The crossbred yearling daughters of Columbia and Cotswold rams had an advantage in weight of 5 to 7 pounds compared to ewes sired by crossbred rams and out of crossbred dams developed from Corriedale x Navajo and Romney x Navajo crosses. The Cotswold crossbreds having three-fourths improved blood were better in type and condition, but had more color on face and legs and more face covering than the ewes of other crossbred lines. The first cross Columbia x Navajo ewes showed satisfactory improvement over Navajo ewes with respect to body weight, type, condition, and color but had more face covering.

BODY WEIGHTS AND SCORES OF YEARLING EWES

Line no.	Pen no.	No. of ewes	Body weight	Face covering score	Type score	Condition score	Color score
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NAVAJO:

1	1	21	83.38	2.08	3.33	3.10	2.62
2	2	18	86.11	2.05	3.26	3.15	2.28
Total & Average		39	84.64	2.07	3.29	3.13	2.46

CROSSBRED X CROSSBRED:

3	W7	18	88.61	1.99	3.02	2.95	2.28
3	W8	19	86.74	2.38	3.11	3.01	2.95
3	W9	6	84.67	2.81	3.00	3.08	3.00
3	W10	14	88.07	2.57	2.95	2.86	2.57
Total & Average		57	87.44	2.35	3.03	2.96	2.65

CROSSBRED X CROSSBRED:

4	W11	6	94.33	2.50	2.83	2.64	1.33
4	W12	12	87.17	2.16	3.25	3.07	1.25
4	W13	14	84.93	1.90	2.67	2.80	2.00
4	W14	16	85.06	1.81	2.98	3.09	1.63
Total & Average		48	86.71	2.01	2.94	2.95	1.60

COTSWOLD X CROSSBRED:

5	W15	25	94.88	2.53	2.65	2.61	2.12
5	W16	22	91.64	2.38	2.85	2.67	3.64
5	W17	10	91.20	2.82	2.92	2.95	3.00
Total & Average		57	92.98	2.53	2.78	2.69	2.86

COLUMBIA X NAVAJO:

6	W1	12	90.08	2.35	3.06	2.97	1.42
6	W2	10	98.40	2.10	2.69	2.57	1.20
6	W3	11	94.91	2.50	2.88	2.85	1.36
6	W4	15	95.67	2.20	2.90	2.88	2.53
6	W5	10	96.00	2.37	2.87	2.77	1.40
6	W6	12	88.42	2.79	3.04	2.96	1.92
Total & Average		70	93.79	2.39	2.91	2.84	1.70

BODY WEIGHTS AND SCORES OF YEARLING NAVAJO AND CROSSBRED RAMS

Yearling body weights and scores were obtained on 61 crossbred rams and 2 Navajo rams. The scores for face covering and color were taken before the rams were sheared while body weights, type and condition scores were taken immediately after shearing. The data are summarized in the following tabulation:

Line no.	No. of rams	Body weight	Face covering score	Type score	Condition score	Color score
<u>NAVAJO:</u>						
1 & 2	2	115.00	2.25	3.17	3.09	1.50
<u>CROSSBRED X CROSSBRED:</u>						
3	14	117.21	2.78	3.16	3.06	1.57
<u>CROSSBRED X CROSSBRED:</u>						
4	10	110.80	2.39	3.35	3.17	1.30
<u>COTSWOLD X CROSSBRED:</u>						
5	21	118.09	2.78	2.90	2.79	1.86
<u>COLUMBIA X NAVAJO:</u>						
6	16	128.20	2.68	2.91	2.69	1.44

The F₁ Columbia x Navajo rams, with an average weight of 128.2 pounds had an advantage of 13.2 pounds compared to Navajo rams, and exceeded the average weights of crossbred rams in other lines by 10 to 18 pounds. Rams of line 4 averaged about 4 pounds lighter in weight than Navajo rams, while the rams of lines 3 and 5 averaged 2 to 3 pounds heavier than the Navajo rams.

All rams of both Navajo and crossbred types were definitely open faced, but Navajo rams scored slightly higher for this trait than did the crossbred rams.

The first cross Columbia x Navajo rams were about equal in type and condition to those sired by Cotswold rams and out of crossbred ewes. The rams of both Columbia and Cotswold crosses were superior in these traits to Navajo rams and crossbred rams of lines 3 and 4. Lines 3 and 4 are reciprocal, line-bred crosses having about one half Navajo and one half improved blood, the latter being predominately from the Corriedale and Romney breeds. The Cotswold crossbreds had slightly more color on face and legs than Navajo rams or crossbred rams of other lines.

CORING OF RESERVATION WOOL

For many years it has been deemed desirable to obtain some basic information on the shrinkage and quality of wools produced on the reservation. In general, reservation produced wool has been subject to considerable discrimination by the wool trade because of heavy shrinkage, poor preparation, and variation in grade. It is the consensus of opinion that marked improvement in the quality of reservation wool has occurred in recent years. With this thought in mind an attempt was made in the spring of 1947 to core sample and evaluate some reservation wool. The cooperation of traders was solicited and six responded. The clip from the tribal owned Rambouillet rams was also sampled. Following is a brief report on the results obtained:

1. District #2 - Navajo Mountain, Arizona
Shrinkage: 67.42%
Grade: Mixed qualities
Comments on sample: The clip was very poorly prepared and the fleeces were untied. Hairy wool, mohair, and colored wools were all bagged together with a considerable quantity of fine, short staple wool.
2. District #3 - Tuba City, Arizona
Shrinkage: 71.08%
Grade: Fine wool of clothing length
Comments on sample: The sample contained many cockle burrs and occasional pieces of binder twine. Most of the fleeces had been tied with paper twine. The scoured wool was very soft and white.
3. District #14 - Tohatchi, New Mexico
Shrinkage: 70.40%
Grade: Fine
Comments on sample: The sample contained considerable wool of good character and of combing length. The clip was well prepared, practically free of burrs, and the scoured wool was very soft and white.
4. District #17 - Klagetoh, Arizona
Shrinkage:
Sort 1 - 70.41%. Sort 2 - 65.39%
Grade: An attempt was made on this lot of wool to sort it into two classifications. Sort 1 was fine wool, mainly of clothing length. Sort 2 contained the coarser, longer stapled wools and all fleeces of a hairy nature.

Comments on sample: The lot was well prepared, particularly Sort 1. Sort 2 contained some fine wool with good staple that would have added to the value of Sort 1.

5. Zuni Pueblo - Zuni, New Mexico

Shrinkage: 71.85%

Grade: Fine wool mainly of clothing length

Comments on sample: All fleeces were untied.

The sample contained considerable cockle burrs and heavy tag locks. The scoured wool was very soft and white.

6. Navajo Tribal owned rams

Shrinkage: 76.45%

Grade: Fine wool of combing and clothing length

Comments on sample: The entire clip was from Rambouillet rams. Staple length, in general, was good. Cockle burrs were quite plentiful in the sample.

The results of the work above cited indicate that much of the discrimination against reservation produced wools seems hardly justified. It is admitted, however, that further improvement could be made in the preparation of many clips. The typing of all fleeces should be emphasized and some attempt should be made toward sorting or rough grading. The almost complete lack of Navajo wools of a hairy nature was very evident in most samples.

EFFECT OF TWINNING ON LAMB PRODUCTION AND INCOME PER EWE

It is the opinion of many range sheepmen that single lambs are more profitable than twin lambs. This viewpoint probably stems from the fact that ewes of most breeds common to this area generally do not produce sufficient milk, under range conditions, to raise more than one good lamb. Navajo ewes possess a high degree of adaptability, are good mothers and usually have an abundant supply of milk, which enables them to raise a high percentage of twin lambs. The advantages of twin lambs over single lambs with respect to pounds of lamb weaned per ewe lambing and market value of the lambs, based on 1947 production records and prices are shown in the following table. About 53 percent of the Navajo and 47 percent of the crossbred matings produced twin lambs. Navajo ewes that twinned actually weaned 104.2 pounds of lamb per ewe lambing compared with 61.5 pounds for ewes with single lambs. Comparable figures for all crossbred matings were 101.5 and 59.9 pounds. In both instances twinning shows an advantage of about 42 pounds of lamb per ewe when weaning weights of the lambs were adjusted for differences in age and sex of the lambs. Among the progeny of crossbred matings the mortality of lambs from birth to weaning age was only two percent greater for

EFFECT OF TWINNING ON LAMB PRODUCTION
AND
INCOME PER EWE

Type of matings	Birth type of lambs	No. of ewes	Percent of total ewes lambing	Lambs born	Lambs weaned	Percent of lambs weaned of ewes lambing	Average adjusted weaning weight of lambs	Pounds of lamb weaned per ewe ¹ lambing	Market value of lambs ²
<u>NAVAJO:</u>									
	Singles	46	47.4	46	43	93.4	65.8	61.5	11.07
	Twins	51	52.6	102	96	188.2	55.3	104.2	18.76
<u>CROSSBREED:</u>									
	Singles	312	52.7	312	262	84.0	71.1	59.7	10.75
	Twins	280	47.3	560	458	163.6	52.1	101.5	18.27

¹Weights adjusted for age and sex on basis of ewes at 140 days of age.

²Market value of lambs figured as 18 cents per pound.

twin lambs than it was for single lambs. In the Navajo strain the difference in mortality of twin and single lambs was only 0.6 of one percent.

Of the various factors affecting the pounds of lamb weaned per ewe bred, rate of reproduction was by far the most important factor. The annual lamb crop of the United States averages 70 to 80 percent of ewes bred. Therefore, improvement in adaptability, fertility and fecundity of the breeding stock offers the greatest possibility for increasing economic returns from lamb production.

WOOL DISPOSITION - 1946

<u>Production and Sales</u>	<u>Pounds</u>
1946 Wool Clip	5219
Carried forward from 1945 clip	<u>168</u>
Total wool on hand June 15, 1946	5387
 <u>Wool Sold or Used Experimentally</u>	
Navajo Cooperative Stores	2080
Indian Traders	2104
Individual Indians	831
Indian Service Schools	321
Used experimentally	<u>51</u>
	5387

SALES OF RAMS TO INDIANS DURING 1947

A total of 57 crossbred breeding rams, including 49 yearlings, seven 2-year olds and one 4-year old ram were sold to individual Navajo Indians during the year 1947, for use in the improvement of their flocks. Also, five yearling rams were sold to the Hopi Indian Agency to be used in a tribal owned flock. The total of 62 rams sold represents a considerable increase in ram sales by the laboratory compared to any previous year, and is evidence of the growing interest among Indians in the sheep breeding program of the laboratory. Approximately one-half of the rams were sold during the month of April when many Indians from the reservation visited the laboratory. The remainder of the rams were sold by the early part of November, and several requests for rams during the latter part of the month could not be filled.

Following is a summary of ram sales by Districts of the Navajo Reservation and including the Hopi tribal herd:

Number of
rams sold

District
number

25
8
9
7
2
2
2
2
5

3
7
12
11
14
16
17
18

Hopi Indian Agency

Efforts to concentrate the use of these rams in a few areas, so as to permit evaluation of breeding results, have not been very successful to date, but it is believed that greater progress toward this objective will be possible if the rams produce results that are satisfactory to the Indians.

Average body weights of the yearling and mature rams after they were sheared in June 1947 were 117 pounds and 157 pounds, respectively. Average fleece weight of the yearling rams was 11.0 pounds with a clean yield of almost 6.0 pounds. Average staple length was 7.2 inches and the average grade was 48's, which is the desired objective in wool fineness. The mature rams, all of which had been used in the breeding program of the laboratory, had an average fleece weight of 12.6 pounds, with a clean yield of 6.9 pounds. The average grade was 50's.

WOOL SCHOOL HELD AT LABORATORY

A Wool School held at the laboratory March 17 to 20, 1947, was attended by a total of 30 Indian Service personnel, including District Supervisors from all 17 districts of the Navajo Reservation, several Stockmen, Range Examiners, Conservationists, and other Navajo Service field personnel, also two representatives from the Hopi Indian Agency. Several persons who expressed a desire to attend the Wool School could not be accommodated because of lack of space.

The four day program included lectures, discussions, demonstrations, educational films, and a tour of inspection of the laboratory and experimental flocks of sheep. Navajo Service personnel in charge of extension and livestock work on the reservation assisted laboratory personnel in conducting the program.

The primary purpose of the Wool School was to acquaint Navajo Service field personnel with the organization and objectives of the laboratory, the accomplishments of the work to date, and its practical application in improving sheep and wool to meet the requirements of the Indians. This was the first visit to the laboratory for many of those attending the Wool School, and the enthusiastic response indicated that the School was definitely worthwhile. In commenting on the benefits of the Wool School several Supervisors expressed the

opinion that it would be a real aid to them in discussing the work of the laboratory with the Navajo people and the traders of their districts. At the conclusion of the Wool School the group recommended that it be held annually.

After the Supervisors had told Indians in their district about attending the Wool School, many of the Indians asked if they too might visit the laboratory. The result was that about 100 Indians, including groups from districts 3, 7, and 11 of the Navajo Reservation, the Hopi and Zuni Reservations, and Navajos from the Ramah community adjacent to the Zuni Reservation, visited the laboratory during the month of April. A majority of these visitors showed much interest in the sheep and wool, also in the experimental weaving and other phases of the laboratory work. Indian leaders of the various groups later reported at their district meetings on their visit to the laboratory, with the result that other Indians expressed a desire to visit the laboratory. As more Indians learn about the research program of the laboratory and its potential benefits to their sheep and hand weaving industries, interest in the work will grow and efforts to extend the practical application of results will be more fruitful.

